

References

1. Buchberger, B., Collins, G.E., Loos, R. (ed.): *Computer Algebra: Symbolic and Algebraic Computation*, 2nd edn. Springer, Vienna (1983)
2. Davenport, J.H., Siret, Y., Tournier, E.: *Computer Algebra: Systems and Algorithms for Algebraic Computation*, 2nd edn. Academic Press, London (1993)
3. Geddes, K.O., Czapor, S.R., Labahn, G.: *Algorithms for Computer Algebra*. Kluwer Academic Publishers, Boston (1992)
4. von zur Gathen, J., Gerhard, J.: *Modern Computer Algebra*, 2nd edn. Cambridge University Press, Cambridge (2003)
5. Grozin, A.G.: *Using REDUCE in High Energy Physics*. Cambridge University Press, New York (1997); paperback edition (2005)
6. Wolfram, S.: *The Mathematica Book*, 5th edn. Wolfram Media, Champaign (2003)
7. Trott, M.: *The Mathematica GuideBook for Symbolics*. Springer Science+Business Media, Inc., New York (2006)
8. Trott, M.: *The Mathematica GuideBook for Numerics*. Springer Science+Business Media, Inc., New York (2006)
9. Trott, M.: *The Mathematica GuideBook for Graphics*. Springer, New York (2004)
10. Trott, M.: *The Mathematica GuideBook for Programming*. Springer, New York (2004)
11. Mangano, S.: *Mathematica Cookbook*, O'Reilly Media, Inc., Sebastopol, CA (2010)
12. Cox, D., Little, J., O'Shea, D.: *Ideals, Varieties, and Algorithms*, 3rd edn. Springer, New York (2007)
13. Arzhantsev, I.V.: *Gröbner Bases and Systems of Algebraic Equations* (in Russian), 3rd edn. MCCMO, Moscow (2003). <http://www.mccme.ru/free-books/dubna/arjantsev.pdf>
14. Kredel, H., Weispfenning, V.: J. Symbolic Computing dimension and independent sets for polynomial ideals **6**, 231 (1988)
15. Fateman, R.J.: A review of *Mathematica*. J. Symbolic Comput. **13**, 545 (1992). (<http://www.cs.berkeley.edu/~fateman/papers/mma.pdf>); <http://www.cs.berkeley.edu/~fateman/papers/mma6rev.pdf>
16. Bronstein, M.: *Symbolic Integration I*. Springer, Berlin (1997)
17. Davenport, J.H.: On the integration of algebraic functions. In: *Lecture notes in computer science*, vol. 102. Springer, New York (1981)
18. Landau, L.D., Lifshitz, E.M.: *Quantum Mechanics: Non-relativistic Theory*, 3rd edn. Butterworth-Heinemann, Oxford (1981)
19. Landau, L.D., Lifshitz, E.M.: *Mechanics*, 3rd edn. Butterworth-Heinemann, Oxford (1982)
20. Landau, L.D., Lifshitz, E.M.: *The Classical Theory of Fields*, 4th edn. Butterworth-Heinemann, Oxford (1980)
21. Landau, L.D., Lifshitz, E.M., Pitaevskii, L.P.: *Electrodynamics of Continuous Media*, 2nd edn. Butterworth-Heinemann, Oxford (1995)

22. Berestetskii, V.B., Lifshitz, E.M., Pitaevskii, L.P.: Quantum Electrodynamics, 2nd edn. Butterworth-Heinemann, Oxford (1982)
23. Prudnikov, A.P., Brychkov, Yu.A., Marichev, O.I.: Integrals and Series, vol. 3, Chapter 7. Gordon and Breach, New York (1990)
24. NIST Handbook of Mathematical Functions, ed. by F.W.J. Olver, D.W. Lozier, R.F. Boisvert, C.W. Clark, Cambridge University Press, Cambridge (2010). <http://dlmf.nist.gov/>
25. <http://functions.wolfram.com/>
26. Grozin, A.G.: Lectures on QED and QCD: Practical calculation and renormalization of one- and multi-loop Feynman diagrams. World Scientific (2007)
27. Cvitanović, P.: Group Theory. Princeton University Press, Princeton (2008). <http://www.nbi.dk/GroupTheory/>

Index

Symbols

””, 22, 43–46, 77, 99–104, 106–107, 130,
131, 136, 141, 151, 161–162, 166, 169,
173–174, 177–178, 185
!=, 45, 47
., 93–97, 194
/., 17–19, 27–28, 38, 40
//., 28–33, 167–170, 177
/;, 41–42
/;;, 32–33, 39, 103, 135, 194
::, 9, 107–108, 161
:=, 35–41, 43, 44, 46, 48, 51–52, 68, 74,
81–89, 100–101, 107, 120, 125, 126,
128, 129, 134, 135, 139, 154, 156, 159,
161, 162, 167–170, 174, 178, 181, 186,
188, 194, 196, 202–205, 207
: >, 35–36, 167–169, 171
;;, 9, 43–44
::, 23–24, 76
?, 37–38, 41, 108
[[]], 14, (23, 18–24, 57, 58, 60, 61, 74, 76, 78,
80, 82, 83, 85–89, 92, 95, 196
[], 9, 12–13, 22
%, 12, 57, 58, 67, 68
&&, 118, 123, 198, 208
→, 27–28, 45–46, 103
_?, 32
_., 30–32, 146, 148, 150
_→, 33, 103
_→→, 33, 40, 103, 167–170
` , 24–25, 37–38, 41, 73–75, 105–108
~~, 103–104
{ }, 14
*=:, 47
+++, 47, 92
+=, 92, 156, 159
–=, 141

–>, 17–19, 27–28, 35–36, 65
<<, 99–101, 106, 108, 158
<>, 102
=!=, 45, 161–162
=, 9, 22, 35–39, 51–52, 92–93, 95–96
==, 18, 33, 44–45, 60, 70–71, 76, 78, 80, 82–
89, 116, 123, 129, 134–135, 147–150,
156, 159, 168, 170–171, 177, 180, 183,
185, 190, 195, 200, 201, 205
===, 45, 162
>>, 100
^:=, 41
^=, 42
||, 33
|, 97, 103
\$Assumptions, 69, 97–98
\$Context, 105–107
\$ContextPath, 105–107
\$KernelID, 50–51
\$Path, 100, 106
\$RecursionLimit, 9

A

Abort, 161
Abs, 126, 156, 180, 188–190
Accuracy, 74
AccuracyGoal, 77
All, 92, 120, 177, 181
Antisymmetric, 97
Apart, 12
Appearance, 11, 130, 131, 136
Append, 100, 168, 196, 207
Apply, 48, 175, 179, 182, 184, 188
ArcSin, 69, 173, 177, 180, 181, 184–186, 190
ArcTan, 66, 177
Array, 91–92, 195
Arrays, 97–98

Assumptions, 69, 135
 AtomQ, 24
 Attributes, 40–41, 52–53
 Automatic, 75
 AxesLabel, 155

B

Begin, 106–108
 BeginPackage, 107–108
 BesselI, 69
 Binomial, 70
 Blank, 32–33, 103
 Block, 49
 Boxed, 184, 207, 208

C

Cancel, 12, 88, 131, 205
 CForm, 102
 Circle, 173–175, 179, 182, 188
 Clear, 9, 12, 14, 18, 19, 22, 24–26, 28, 31–33,
 35–44, 46–53, 57, 59–61, 64–67, 74,
 76, 78, 80, 82–84, 86–89, 93–95, 97,
 100–103, 105, 107, 118, 121, 122, 129,
 135, 140, 147, 149, 159, 168, 170, 177,
 181, 185, 194, 195, 197, 201, 202, 205
 ClearAll, 41, 52
 Close, 101
 Coefficient, 11, 80, 82–89, 146–150, 200, 205
 Collect, 11, 156, 159
 Complex, 24
 ComplexExpand, 60
 ComplexInfinity, 76
 ComposeSeries, 65–66
 CompoundExpression, 43
 Condition, 32–33
 ConditionalExpression, 69
 Cone, 184
 Conjugate, 137
 Context, 105–107
 ContourPlot, 116, 200
 ContourPlot3D, 123
 Contours, 116
 Cos, 12–13, (64, (67, 15–67, 71, 78,
 112, 113, 121, 122, 125–126, 135–136,
 146–151, 163, 173–174, 176–177,
 179–182, 184–186, 188
 Cot, 63, 134, 163
 Cross, 97
 Csc, 69, 71
 Cycles, 97–98
 Cylinder, 193, 207

D

D, 13–14, 38, 65, 67–68, 80–81, 83–89, 128,
 134, 146–151, 158, 161, 162, 177, 181,
 183, 186, 190
 Darker, 202, 206
 Dashed, 113
 DeclarePackage, 106
 Degree, 190
 DegreeLexicographic, 59, 61–62
 Denominator, 25, 126
 Derivative, 67–68
 Det, 94–95, 196
 Dimensions, 93
 DirectedInfinity, 64
 Disk, 139
 DistributeDefinitions, 50–51
 Do, 46, 63, 74, 95, 126, 141, 148, 150, 154,
 156, 159, (162, (162, 161–162, 188, 194,
 196, 200, 205, 207
 DSolve, 70–71, 78, 129, 134–135

E

E, 10, 12, 68, 70–71
 Eigensystem, 95–97
 Eigenvalues, 95
 Eigenvectors, 95
 Element, 95, 97–98
 EllipticF, 69
 End, 106–108
 EndPackage, 107–108
 Erfi, 69
 EulerSum, 106
 Evaluate, 52–53, 66, 130, 163, 176, 180, 189
 EvenQ, 126, 150
 Exp, 12–13, 15, 63, 65–69, (134, 76–135
 Expand, 10–11, 35–36, 38, 41, 57, 58, 60, 67,
 68, 84, 87, 107, 135, 141, 157, 167, 169,
 207
 ExpandAll, 82, 88, 89, 147–151
 Exponent, 11
 Extension, 11, 12

F

Factor, 11–12, 61, 135, 156, 198–199, 201
 Factorial, 10
 False, 24–25, 39, 45, 93, 104, 184, 193, 207,
 208
 FilePrint, 99–102, 107
 FindIntegerNullVector, 77
 First, 18, 47
 Fit, 117
 Flat, 40
 For, 47
 FortranForm, 102

- FractionalPart, 125
 FreeQ, 45
 FullForm, 24–26, 28–33, 35, 43, 63–64, 67–68, 73–74, 102–103
 Function, 47–49, 51, 91–92, 141
- G**
 Gamma, 69, 135
 Get, 100
 Global, 37, 38, 105–107
 Graphics, 139–140, 173–176, 178–179, 182, 188, 202
 Graphics3D, 184, 193, 205–207
 Greater, 33
 GroebnerBasis, 59–62, 198–199
- H**
 Head, 22–24, 27, 48
 Hold, 9, 25–26, 29, 43, 53
 HoldAll, 52–53
 HoldFirst, 52
 Hypergeometric2F1Regularized, 69
- I**
 I, 11–12, 21, 24, 131, 134–135
 If, 44, 126, 139, 141, 150, 154, 156, 159, 161–162, 168, 175, 179, 182, 186, 188, 196, 208
 Im, 25
 Import, 166, 169, 185
 Indeterminate, 76
 Infinity, 14, 64, 67, 70, 77, 129, 131
 Inset, 173–174, 178
 Integer, 24, 27, 32–33, 125
 IntegerQ, 25
 Integrate, 14, 51, 65, 68–69, 129, 131, 135, 137
 InterpolatingFunction, 78
 Inverse, 94, 96, 161
 InverseSeries, 65–66, 158–159
- J**
 Join, 100, 139, 168, 174–176, 179, 181–182, 184, 188
 JordanDecomposition, 96
- K**
 KroneckerDelta, 70
- L**
 Length, 22, 161
 Line, 139, 173–174, 178–179, 181–182, 184, 188
 LinearSolve, 94
 List, 25, 28, 32, 50, 63–64
- Listable, 41, 50
 ListPlot, (117, 75–117
 Log, 12–14, 64, 68–69, 77, 80, 83–84, 86–88
 LogIntegral, 68
 LogLogPlot, 114–115
 LogPlot, 114
- M**
 MachineNumberQ, 73
 MachinePrecision, 73
 Manipulate, (15, (16, (121, 11–122, 130–131, 136, 174–176, 179, 182, 188, 208
 Map, 48–49, 75, 76, 146–151, 167–171, 198, 199
 MatchQ, 45
 Matrices, 97
 MatrixForm, 91–96, 194–195
 MatrixPower, 94
 MatrixQ, 93
 MatrixRank, 95
 Max, 156
 Message, 161
 Method, 77
 Min, 156
 Mod, 135, 188–190
 Module, 49, 74, 126, 141, 161, 162, 167–170, 181, 184, 188, 207
- N**
 N, 10, 73–74, 117, 126, 201, 205
 ND, 106
 NDSolve, 78
 NIntegrate, 77
 NLimit, 106
 Normal, 66, 151
 Not, 39, 45
 NResidue, 106
 NSeries, 106
 NSolve, 76
 NSum, 77
 NSumTerms, 77
 Null, 43
 NullSpace, 95
 NumberQ, 32, 45
 Numerator, 25, 205
 NumericalCalculus, 106
 NumericQ, 45
- O**
 OddQ, 150
 Opacity, 184
 OpenWrite, 101
 Options, 40, 162
 OptionsPattern, 40, 161

OptionValue, 40, 162
 OrderedQ, 39
 Orderless, 40–41
 OutputStream, 101

P

Parallelize, 50–51, 131
 ParametricPlot, (115, 15–115, 154–156,
 185–186, 202–204
 ParametricPlot3D, (121, 16–122, 205–206
 Part, 22–23
 Pattern, 32–33, 103
 Pi, 10, 12, 16–17, 45, 51, 53, 66, 69, (125,
 76–126, 131, 135, 137
 Plot, (52, 15–53, 66, (78, (111, 76–114, 117,
 130–131, 176–178, 180–181, 183,
 186–190
 Plot3D, 15–16, 101, 120
 PlotMarkers, 75
 PlotPoints, 123
 PlotRange, 15, 16, 75, 114, 120, 122, 130, 131,
 155, 174–179, 181, 182, 185, 187–188,
 202–205, 208
 PlotStyle, 112–113, 177, 181, 185, 187, 189,
 190
 Plus, 25–27, 31–33, 40, 41, 46, 48, 67
 Point, 202, 205–206
 PointSize, 202, 205–206
 PolyLog, 68
 PolynomialReduce, 57–59
 Power, 25–26, 28–31, 64, 67, 102
 Precision, 73–76
 PrecisionGoal, 77
 Prepend, 66, 100
 Print, 43, 44, 46–47, 50, 63, 95, 101, 141, 148,
 156, 159, 162, 207
 Put, 100

Q

Quaternion, 106
 Quaternions, 106
 Quotient, 135

R

Random, 184
 Rational, 24–25, 28, 63–64, 125
 Re, 25
 Real, 24
 Reals, 76, 95, 97–98
 RegionPlot, 118, 198
 RegionPlot3D, 123
 ReleaseHold, 53
 Remove, 105
 ReplaceAll, 29

ReplaceRepeated, 29
 Rest, 47
 Rule, 29, 32–33

S

Save, 101, 151
 Select, 48
 Series, 14, 63–66, 145–150, 157–159
 SeriesCoefficient, 63, 66–67, 146, 148, 150
 SeriesData, 63–64
 Set, 25–26, 52
 SetDelayed, 35, 52
 Show, 117–118, 140, 166, 169, 185–186,
 202–204, 206–208
 Simplify, 13, 95, 126, 151, 154, 156, 158–159,
 161, 162, 177, 180–181, 187, 191, 202,
 207
 Sin, 12–13, (64, 15–67, 69, 71, (102, 76–102,
 112–113, 115, 117, 120–122, 125,
 134–137, 163, 173–174, 177, (179, (180,
 179–182, 184–186, 188
 Solve, 18–19, 45, 60, 80, 129, 135, 147–150,
 170–171, 176–177, 180, 183–185, 190,
 195, 200–201, 205
 Span, 23
 Sphere, 193, 207
 Sqrt, 11–13, 28, 64, 120, 128–129, 131, 135,
 141, 151, 154, 173, 174, 179–181, 185,
 188, 193, 201, 206–208
 StreamPlot, 119
 StringExpression, 103
 StringFreeQ, 104
 StringLength, 103
 StringMatchQ, 103–104
 StringReplace, 103
 StringSplit, 104
 Style, 173–174, 178, 202
 Sum, 14, 67, 70, 81, 83–89, 146–150, 157, 162,
 195
 Switch, 45–46
 Symmetric, 97–98
 System, 105, 107

T

Table, (50, 50–51, 53, 66, 74, 80, 82–89,
 91–92, 117, 125, 129–131, 135–137,
 139, 156, 159, 161–163, 165, 168, 175,
 179, 182, 184, 188–191, 194–196, 207
 Tan, 64–65, 113–114, 174, 184
 TensorContract, 97–98
 TensorDimensions, 98
 TensorProduct, 97–98
 TensorRank, 98
 TensorReduce, 97–98

TensorSymmetry, 98
TeXForm, 102
Text, 139, 202
Ticks, 155
Times, 25, 28–33, 40–41, 46, 48, 50, 64, 67
Together, 12, 14, 26, 80, 94, 95, 128, 134, 205
Tr, 94
Transpose, 94
TreeForm, (26, 23–26
TrigExpand, 13, 180, 185, 187, 191
TrigReduce, 13, 146–151
True, 24–25, 39, 44–45, 67, 69, 73, 82–86, 88,
93, 98, 104, 126, 161, 162, 205

V

VectorPlot, 119

VectorQ, 93
Vectors, 97
ViewPoint, 123, 184, 193, 205, 207, 208

W

Which, 44, 125, 205
While, 47
With, 50, 120, 139, 173–175, 179, 181–182,
184, 188, 202–205
WorkingPrecision, 77
Write, 101

Z

Zeta, 14, 77, 165, 170